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Research Article

ANALYSIS OF PHYTOCHEMICAL ACTIVITY OF *BOUGAINVILLEA SPECTABILIS, DELONIX REGIA* AND *MUSSAENDA PHILIPPICA* FLOWERS

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ABSTRACT

Medicinal plants are additionally strong wellspring of naturally dynamic compound and offering expansive range of movement or activity. As a potent source of biologically active compounds, medicinal plants have long been an area of interest for effective chemotherapeutic agents because they offer a wide range of activities, with a focus on prevention. Therapeutic plants give various advantages to human wellbeing. Due to their natural origin and high therapeutic value, medicinal plants have gained more prominence. The purpose of this study was to determine whether *Bougainvillea spectabilis* (Paper Flower), *Delonix regia (Gulmohar)* and *Mussaenda philippica (Bedina)* contained phytochemicals. The phytoconstituents like alkaloids, glycosides, flavonoids, phenolics, quinones, phlobotannins, saponins, terpenoids and tannins were accounted for as the premise of restorative properties. Acetone, chloroform and water were used for the extraction purpose. *Bougainvillea spectabilis* is accounted for to have restorative qualities including anticancer, anti-hepatotoxic, anti-inflammatory, antimicrobial, antihyperlipidemic, antioxidant cancer prevention agent and antiulcer properties. Chronic fever, inflammation, antimicrobial constipation, arthritis, piles, hemoplagia, boils, scorpion bite, pyorrhea, bronchitis, dysmenorrhea and asthma are just a few of the conditions for which *Delonix regia* has been used. The different types of the class *Mussaenda* has numerous original phytochemical constituents which has high pharmacological exercises, for example, antioxidant, anti-inflammatory, antimicrobial and so on. Useful for treating numerous health disorders.

INTRODUCTION

Plant based medicines or prescriptions have been a part of conventional medical care in many regions of the planet for huge number of years[1]. Numerous therapeutic plants are involved day to day in Ayurvedic practices. In India more than of 7,000 therapeutic plant species are known. These plants were utilized as antimicrobial drugs in traditional medicine because they contained numerous biologically active compounds with antimicrobial properties. More than 80% of the world's population relies on traditional medicine for their primary health care requirements, according to a World Health Organization report[2]. Due to the high rate of the development of resistant pathogens caused by the excessive selection pressures created by the misuse and widespread use of classical antimicrobials like antibiotics, physicians have recently switched to plant-based medicines[3].

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Bougainvillea spectabilis

Bougainvillea spectabilis which is also known as paper flower, is an ornamental plant. It is a rich source of micro and macronutrients like tannins, phenols, saponins, alkaloids, terpenoids, quinones, pinitol, bougainvinones, quercetin, quercetagetin, glycosides, terpinolene, magnesium, calcium,

potassium, manganese, iron, and sodium which is help in the fight against different type of health causing diseases[4-7]. For growth and development of any plant micronutrients and macronutrients provides nutrition. The roots, leaves and branches contain several types of volatile compounds like n-octacos-9-enoic, 2-furfural cadina-1, methyl salicylate terpinolene, 4-diene, linalool which is help in the treatment of inflammation and diabetes[8,9]. Flower have also shown a therapeutic value for treating of low blood pressure[3]. *Bougainvillea spectabilis* is an ancient therapeutic plant with various bioactive combinations obligated for its pharmacological activities, like antioxidant, anti-inflammatory, anti-cancerous, anti-diabetic, anti-bacterial, etc. According to studies, medicinal plants have been utilized in drug development for a long time due to their ease of availability and low risk of side effects. Non-steroidal calming drugs, for instance, are an illustration of a mitigating prescription that can make side impacts and are viewed as hurtful to human wellbeing later on. As a result, it is necessary to develop a less toxic anti-inflammatory medication[10].

Delonix regia

Delonix regia which is generally called *Gulmohar*. *Delonix regia*, also known as Royal Poinciana or Flame Tree, is an ornamental plant with potential medicinal properties that has piqued scientific interest. Due to its striking appearance, which is characterized by vibrant red and orange flowers, and its use in traditional medicine systems. It is a prominent component of landscapes and urban environments due to its widespread presence in tropical and subtropical regions worldwide. Logical interest in *Delonix regia* is propelled by its intricate phytochemical synthesis, which incorporates alkaloids, ß-sitosterol, glycosides carotene, galactomannon, carbohydrates, flavonoids, hydrocarbons, amino acids, lupeol, tannins, steroids, terpenoids, fixed oils, carotenoids, saponins, fats, protein, phytotoxins and phenolic acids in root, bark, leaves and flowers, this plant in order to anticipate various infections and to also disentangle, portray, patent, and market the protective components derived from various parts of this plant in order to popularize these components and serve people. Some piece of the plant has many pharmacological activities such as anti-diarrheal, free radical scavenging properties, anti-helmintic, anti-malarial, anti-diuretic, antioxidant, larvicidal, analgesic, anti-hemolytic, anti-inflammatory, wound healing, hypoglycemic, antiarthritic, hepatoprotective, gastroprotective, haemoglutination, antiemetic, antimicrobial and nutritional. *Gulmohar* is well-known worldwide for its nutritional and therapeutic properties[11].

Mussaenda philippica

Mussaenda philippica is a blossoming plant sort with numerous lovely species. The shrub *Mussaenda philippica* can be found in all of India, the Philippines, and Southeast Asia. *Mussaenda acutifolia, Mussaenda frondosa* and *Mussaenda grandiflora* are its synonyms[12]. Ayurveda, an ancient Indian recuperating framework, portrays numerous herbs, minerals and oils. Since prehistoric times, people have known that plants have medicinal properties. Steroids, flavonoids and triterpenes are just a few of the restorative regular mixtures found in *Mussaenda*. The primary chemical components that can be found throughout the plant are butanedioic acid, tannins, diethyl ester, saponins, caryophyllene, flavonoids, hexadecanoic acid, alkaloids, quinic acid, 1, 2, 3-Benzenetriol, 4-((1E)-3-Hydroxy-1-propenyl)-2-meth-oxyphenol, decahydro2-methoxy and naphthalene. *Mussaenda philippica* nanocomposite improves bioavailability and therapeutic potential[13]. The plant is liked as drug for the treatment of jaundice, loose bowels, stomach ache and flu. The different types of the class *Mussaenda* has numerous novel phytochemical constituents which has high pharmacological exercises, for example, antioxidant, anti-inflammatory, antimicrobial etc.[14] In the present study aimed to analysis of phytochemical activity of *Bougainvillea spectabilis, Delonix regia* and *Mussaenda philippica* flower.

Table 1: Plant Profile: Botanical Classification (Plant Taxonomy)

Botanical Classification	***Bougainvillea spectabilis***	***Delonix regia***	***Mussaenda philippica***
Kingdom	Plantae	Plantae	Plantae
Division	Angiosperms	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Magnoliopsida	Magnoliopsida
Subclass	Apetalae	Rosidae	Asteridae
Order	Caryophyllales	Fabales	Rubiales
Family	Nyctaginaceae	Fabaceae / Leguminosae	Rubiaceae
Genus	Bougainvillea	*Delonix*	Mussaenda
Species	*Bougainvillea spectabilis*	*Delonix regia*	*Mussaenda philippica*

Table 2: Chemical constituents of plant *Bougainvillea spectabilis*, *Delonix regia* and *Mussaenda philippica*

Plant Name	Plant parts	Chemical constituents	References
Bougainvillea spectabilis	Leaves	Alkaloids, 3-O-methyl chiro inositol, methyl salicylate, pinitol, squalene, triterpenoid and D-pinitol	15-20
	Flower	Carrageenan, g-glutamyl cysteinyl glycine, Anthraquinones, triterpenoids and saponins	21-22
Delonix regia	Bark	β-sitosterol, flavonoids, saponin, carotene, phytotoxins, alkaloids and hydrocarbons	23
	Leaves	Lupeol and β-sitosterol	24
	Flower	Tannins, steroids, saponins, flavonoids and alkaloids	
	Seeds	Saponin	
Mussaenda philippica	Leaves	Flavonoids, quercetin steroids, saponins glycosides, tannins, carbohydrates and Phenol	25
	Flower	Quercetin, β-sitosterol glucoside, ferulic acid, β-sitosterol, hypenin and sinapic acid	26
	Whole Plant	Butanedioic acid, tannins, diethyl ester, saponins, Caryophyllene, flavonoids, Hexadecanoic acid, alkaloids, quinic acid, 1, 2, 3-Benzenetriol, 4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol, decahydro2-methoxy and naphthalene	27

MATERIAL AND METHODS

Collection of plant material

Fresh flowers of *Bougainvillea spectabilis* (Paper Flower), *Delonix regia (Gulmohar)* and *Mussaenda philippica (Bedina)* were collected from local parks of Durg Districts of Chhattisgarh, India.

(a) **(b)** **(c)**

Figure 1: Flower of (a) *Bougainvillea spectabilis,* (b) *Delonix regia* and (c) *Mussaenda philippica*

Preparation of extract

After being thoroughly rinsed with running tap water, the test flowers were blotted, air-dried, and ground into a powder using a grinder. After that, 10 grams of powered material were soaked separately for 24 hours at 140 rpm in shaking conditions in 50 milliliters of water, ethanol, and petroleum ether at 25°C temperature. A cheese (muslin) cloth was used to filter the extract, and it was dried at room temperature in the laboratory[28].

Preliminary phytochemical activity

The water, ethanol and petrol ether separate were utilized to screen compound tests to recognize the substance constituents of the test flowers.

Preparation of Reagents

Table 3: Reagent and solution preparation for phytochemical activity of test flowers

S.No.	Name of Reagent and solution	Composition
1.	Wagner's reagent	2g potassium iodide, 1.27g iodine, 100ml distilled water
2.	Benedict's reagent	**Solution A:** 173g sodium citrate, 100g sodium carbonate, 800ml distilled water, dissolved and boil the solution to make a clear solution. **Solution B:** 17.3g copper sulphate, 100ml distilled water **Working solution:** Mix the solution A and B
3.	Millon's reagent	1g mercury, 9ml fumic nitritc acid, add equal amount of distilled water (after completion of reaction)
4.	Ninhydrin solution	10mg ninhydrin, 200ml acetone

Table 4: Qualitative test for phytochemical activity of test flower

Name of the Test	Procedure	Observation (Indicating the positive test)	References
Test for Alkaloids			
Wagner's test	0.5ml of plant extract + 1-2 drops of Wagner's reagent (Along the sides of test tube)	Formation of brown/red precipitate	29-30
Test for Carbohydrates			
Molish's test	0.5ml of plant extract + 2 drops of alcoholic alpha naphthol + 1ml of concentrated sulphuric acid (Along the sides of test tube)	Formed a violet ring	29-30
Test for Reducing Sugars			
Benedict's test	0.5ml of Benedict's reagent + 0.5ml plant extract (boiled for 2 minutes)	Green/red/yellow colour	29-30
Test for Cardiac Glycosides			
Keller-Killani test	0.5ml plant extract + 1.5ml glacial acetic acid + 1 drop of 5% ferric chloride + concentrated sulphuric acid (along the sides of test tube)	A blue colour solution formed	30-33
Test for Proteins			
Millon's test	0.5ml plant extract + add few drops of Millon's reagent	Brick red colour precipitation	29, 34
Test for Amino Acids			
Ninhydrin test	0.5ml plant extract + few drops of ninhydrin solution	A purple colour formed solution	29, 34
Test for Flavonoids			
Alkaline reagent test	1ml of plant extract + 2ml of 2% sodium hydroxide solution (+ few drops of diluted hydrochloric acid)	Formation of an intense yellow colour, which become colourless on addition of diluted acid	29, 34
Test for Phenolic Compounds			
Iodine test	1ml of plant extract + few drops of diluted iodine solution	Appear a transient red colour	30

Test for Tannins			
Braymer's test	0.5ml plant extract + 1.5ml distilled water + 3 drops of ferric chloride solution	Blue-Green colour	30, 35
Test for Phlobatannins			
Hydrochloric acid test	0.5ml plant extract + 0.5ml hydrochloric acid (boiled)	A red precipitate	36-37
Test for Triterpenoids			
Salkoski test	0.5ml of plant extract+ few drops of concentrated sulphuric acid (shaken well and allowed to stand)	Golden yellow layer (at the bottom)	30
Test for Quinones			
Concentrated Hydrochloric acid test	0.5ml of plant extract + concentrated hydrochloric acid	A green colour	38
Test for Saponins			
Foam test	1ml of plant extract + 5ml of distilled water (shaking vigorously)	A persistent foam	39-40

RESULT

The presence of phytoconstituents in the flowers of *Bougainvillea spectabilis*, *Delonix regia*, and *Mussaenda philippica* was examined using water, ethanol, and petroleum ether extract. Alkaloids, carbohydrates, reducing sugars, and flavonoids were found in every extract of *Bougainvillea spectabilis*, according to the findings. Amino acids, phenolic compounds, and saponins were found in both water and ethanol extracts. However, cardiac glycosides, quinones, and proteins and tannins were only found in water extracts, while cardiac glycosides were found in both petroleum ether and ethanol extracts. Phlobatannins and triterpenoids were not found in any *Bougainvillea spectabilis* extract (Shown in Table No. 05).

Table 5: Preliminary phytochemical analysis of *Bougainvillea spectabilis* flower extracted with different solvents

S.No.	Phytochemicals	Extracts		
		Water	Ethanol	Petroleum Ether
1.	Alkaloids	Present	Present	Present
2.	Carbohydrates	Present	Present	Present
3.	Reducing sugars	Present	Present	Present
4.	Glycosides	Present	Absent	Absent
5.	Cardiac glycosides	Absent	Present	Present
6.	Proteins	Absent	Present	Absent
7.	Amino acids	Present	Present	Absent
8.	Flavanoids	Present	Present	Present
9.	Phenolic compounds	Present	Present	Absent
10.	Tannins	Absent	Present	Absent
11.	Phlobatannins	Absent	Absent	Absent
12.	Triterpenoids	Absent	Absent	Absent
13.	Quinones	Present	Absent	Present
14.	Saponins	Present	Present	Absent

All extract of *Delonix regia* contains alkaloids, carbohydrates, reducing sugars, glycosides, flavonoids and triterpanoids. Phlobatannins were only found in water extract, protein, amino acids, tannins, and saponins were

only found in ethanol extract, and cardiac glycosides and quinones were only found in petroleum ether. Phenolic compounds were not found in any *Delonix regia* extract (Shown in Table No. 06).

Table 6: Preliminary phytochemical analysis of *Delonix regia* flower extracted with different solvents

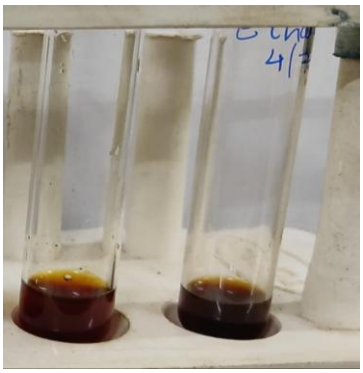
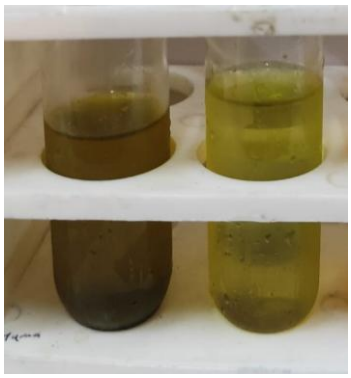
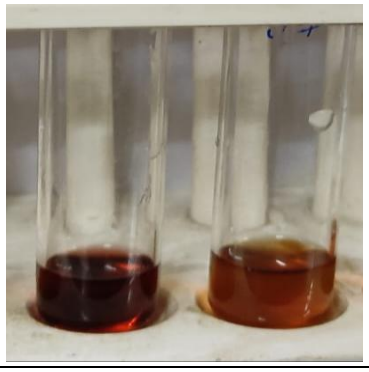
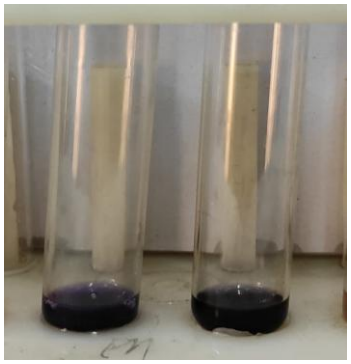
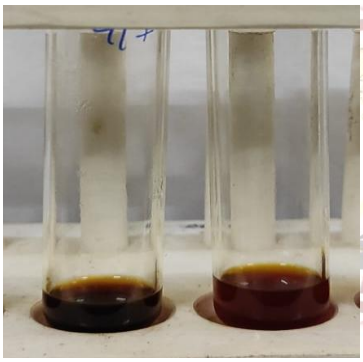
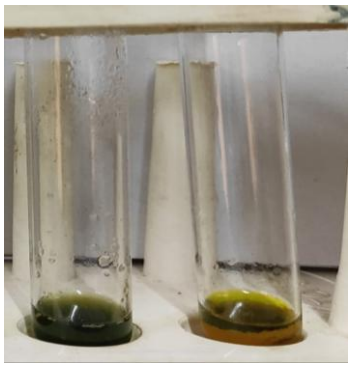
S.No.	Phytochemicals	Extracts		
		Water	Ethanol	Petroleum Ether
1.	Alkaloids	Present	Present	Present
2.	Carbohydrates	Present	Present	Present
3.	Reducing sugars	Present	Present	Present
4.	Glycosides	Present	Present	Present
5.	Cardiac glycosides	Absent	Absent	Present
6.	Proteins	Absent	Present	Absent
7.	Amino acids	Absent	Present	Absent
8.	Flavanoids	Present	Present	Present
9.	Phenolic compounds	Absent	Absent	Absent
10.	Tannins	Absent	Present	Absent
11.	Phlobatannins	Present	Absent	Absent
12.	Triterpenoids	Present	Present	Present
13.	Quinones	Absent	Absent	Present
14.	Saponins	Absent	Present	Absent

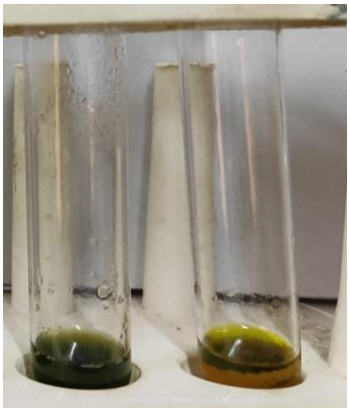
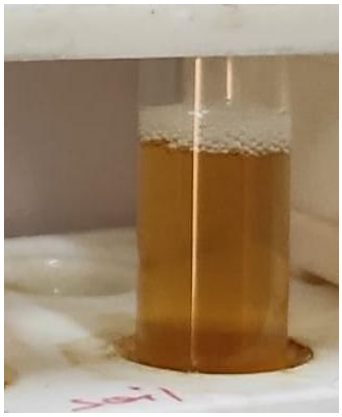
All extract of *Mussaenda philippica* contains alkaloids, carbohydrates and flavonoids. Reducing sugars, proteins, tannins, and triterpenoids were found in both ethanol and water extracts. Glycosides and saponins were only found in water extract, while phenolic compounds and phlobatannins were only found in ethanol extract. No cardiac glycosides, amino acids, or quinones were found in any *Mussaenda philippica* extract (Shown in Table No. 07).

Table 7: Preliminary phytochemical analysis of *Mussaenda philippica* flower extracted with different solvents

S.No.	Phytochemicals	Extracts		
		Water	Ethanol	Petroleum Ether
1.	Alkaloids	Present	Present	Present
2.	Carbohydrates	Present	Present	Present
3.	Reducing sugars	Present	Present	Absent
4.	Glycosides	Present	Absent	Absent
5.	Cardiac glycosides	Absent	Absent	Absent
6.	Proteins	Present	Present	Absent
7.	Amino acids	Absent	Absent	Absent
8.	Flavanoids	Present	Present	Present
9.	Phenolic compounds	Absent	Present	Absent
10.	Tannins	Present	Present	Absent
11.	Phlobatannins	Absent	Present	Absent
12.	Triterpenoids	Present	Present	Absent
13.	Quinones	Absent	Absent	Absent
14.	Saponins	Present	Absent	Absent

Table 8: Preliminary phytochemical analysis of test flower indicating positive responses

Wagner's test for Alkaloids		**Benedict's test for Reducing Sugars**	
Millon's test for Proteins		**Ninhydrin test for Amino Acids**	
Iodine test for Phenolic Compounds		**Braymer's test for Tannins**	
Hydrochloric acid test for Phlobatannins		**Salkoski test for Triterpenoids**	

Concentrated Hydrochloric acid test for Quinones		**Foam test for Saponins**	

DISCUSSION

In the present study the phytochemical activity occurring in the various solvent i.e., water, ethanol and petroleum ether extracts of *Bougainvillea spectabilis*, *Delonix regia* and *Mussaenda philippica* flower were analyzed qualitatively by phytochemical screening. The findings showed that numerous secondary metabolites of therapeutic significance were present. The major phytochemicals were found in the studies were alkaloids, glycosides, proteins, tannins, triterpenoids and saponins. Similar results were found by the other researchers in different extracts. Kumar Swamy *et al*. (2012) studied on ethanolic, ethyl acetate, chloroform and aqueous extract of *Bougainvillea spectabilis* flower were founds phlobatannins, saponins, flavonoids, terpenoids, cardiac glycosides and alkaloids after phytochemical activity[33]. Methanolic extract of *Bougainvillea spectabilis* leaves, bracts and flower shown the presence of flavonoids[41]. Ethanolic extract of *Bougainvillea spectabilis* flower shown the presence of phenolic compounds and glycosides[42]. Kumar *et al*. (2018) studied on petroleum ether, chloroform, and ethyl acetate, methanol and water extract of *Delonix regia* flower were founds saponins, carbohydrates, flavonoids and phenolic compounds[43]. Ethanolic extract of *Delonix regia* flower shown the presence of phenolic compounds, tannins and flavonoids[44]. Methanol, ethyl acetate, acetone and chloroform extracts of *Delonix regia* flower were shown higher quantity of anthocyanin compare to flavonoids, alkaloids, tannins and total phenols[45]. Methanolic extract of *Delonix regia* flower contains phenolic compounds, flavonoids and tannins by phytochemical activity[46]. *Delonix regia* flower extract contains phenolic compounds and flavonoids studied by Ebada *et al* (2023)[47]. Chaniad *et al*. (2022) studied on ethanolic extract of *Mussaenda philippica* flower were founds flavonoids, terpenoids, alkaloids, tannins, anthraquinones, saponins and coumarins[48].

CONCLUSION

Bougainvillea spectabilis, *Delonix regia*, and *Mussaenda philippica* plants are charming natural fortune that rises above its ornamental beauty to offer an abundance of potential for human wellbeing and health being. Through an exhaustive investigation of its phytochemical composition, pharmacological exercises and restorative application, it becomes clear that this plant holds massive commitment in the world of medication and wellbeing. From its rich phytochemical variety enveloping alkaloids, glycosides, proteins, tannins, triterpenoids, saponins, *Bougainvillea spectabilis*, *Delonix regia*, and *Mussaenda philippica* arises as a source of bioactive mixture that show a range of pharmacological exercises.

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